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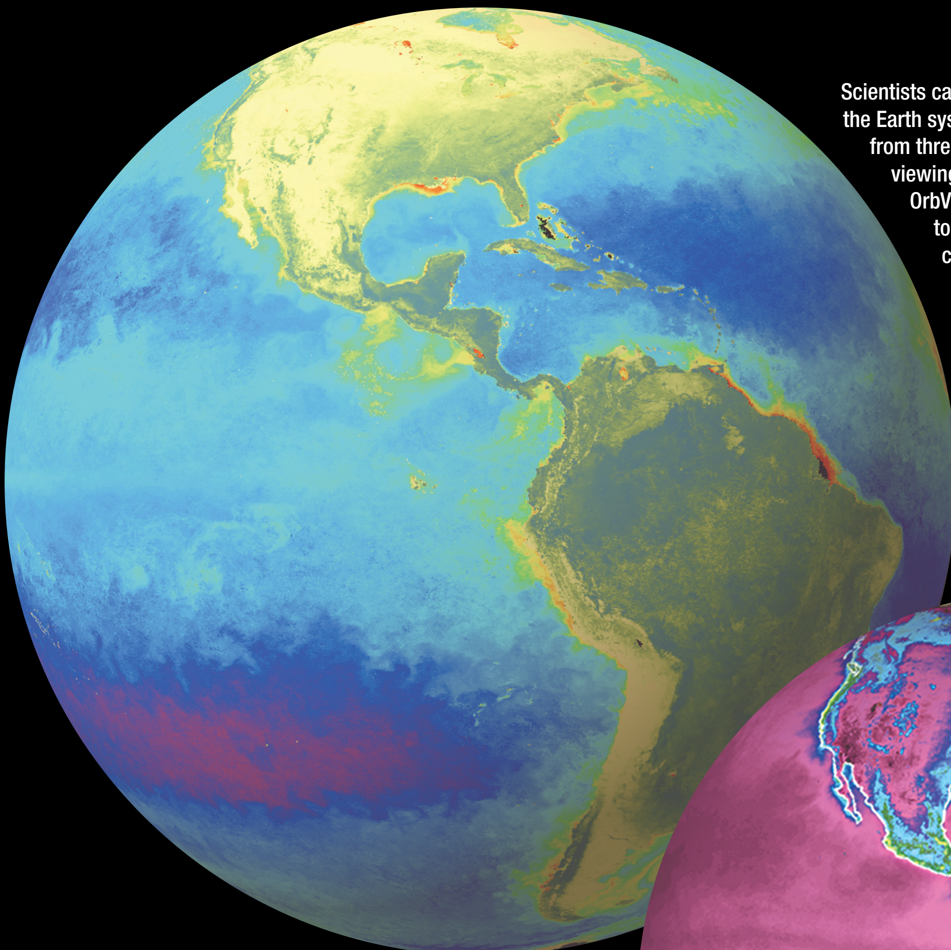
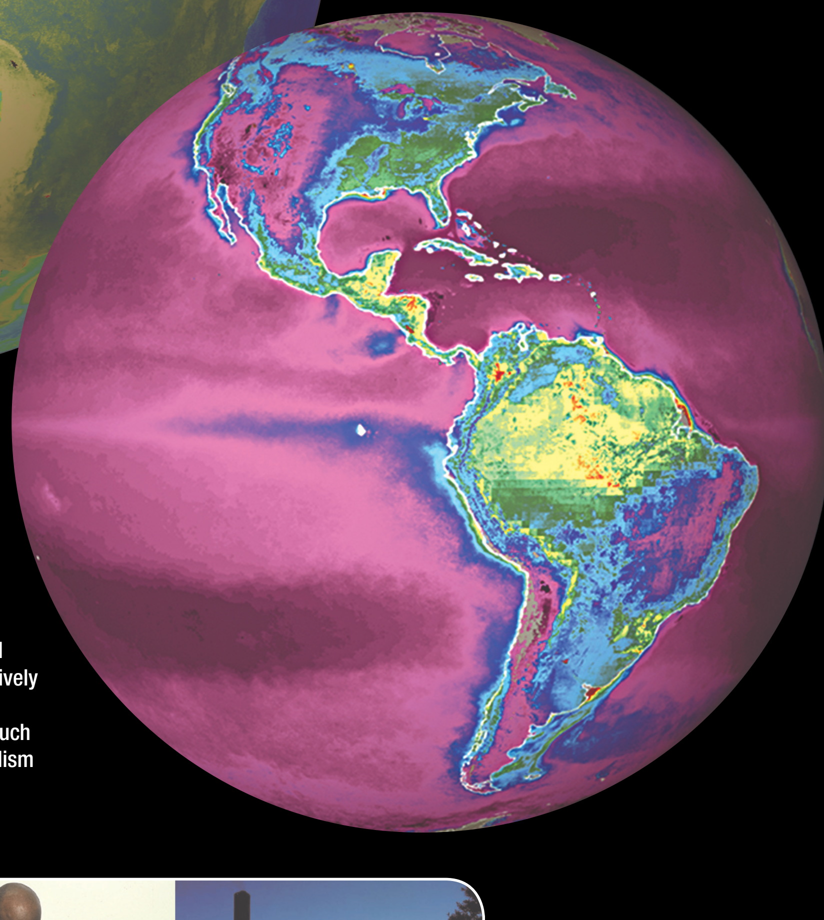
EYES ON CARBON MANAGEMENT



Scientists can track the global circulation of carbon throughout the Earth system from space using datasets like this one derived from three years (1997–2000) of data collected by the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) on the OrbView spacecraft. The SeaWiFS sensor is designed to monitor ocean color changes that are caused by changes in the amount of plant life in the oceans and can also be used to observe changes in plant life on land. Changes in the amount of plant life present impact the amount of carbon that the Earth system can absorb. Having a multi-year record allows scientists to start to determine if the concentration of carbon is increasing or decreasing over time and also allows them to pinpoint areas where concentrations are unusually high or unusually low relative to average values.



Scientists also use Earth observing satellite data to help them monitor the rate at which plants absorb carbon out of the atmosphere—which we might think of as the Earth's metabolism rate. The data shown in this globe comes from the Moderate Resolution Imaging Spectroradiometer (MODIS) on Terra and is compiled for the year 2002. Areas colored red and yellow represent regions of maximum metabolism (the tropical rain forests of Central and South America). Greens, blues, and purples indicate progressively less metabolism. The lowest rates are observed over Earth's oceans. Interestingly though, because the oceans cover so much more surface area than the tropical regions, the total metabolism rate of the oceans is comparable to that of tropical regions.

Informed carbon management enables more efficient energy production, aids climate change mitigation efforts, improves agricultural efficiency, and inspires new technologies for reduction of carbon emissions.

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Overview of the Program

At present, an array of Earth observing satellites are in orbit, and additional launches both by NASA and others will continue throughout the next decade. Our ability to observe our home planet from space has never been greater and will continue to grow. Increasingly, studies of the Earth focus on understanding the Earth's land, atmosphere, oceans, and life as a single integrated system rather than as individual independent elements. NASA is an important contributor in this systems approach to Earth science studies.

In addition to providing Earth observing capabilities, NASA forms strategic partnerships with other government, academic, private, and international organizations. Through these partnerships NASA's Earth science observations and measurements are linked to practical applications. NASA data, information, and predictive models help NASA's partners, and non-traditional users of Earth science, make timely and accurate decisions regarding management of resources and development of policy and maximize the impact of NASA science and technology to benefit society. The goal is ***to make Earth science data and information flow smoothly from satellite to society.***

Carbon Management

Carbon Dioxide (CO_2) is fundamental for life on Earth. Human beings exhale CO_2 as a waste product when they breathe, but plants absorb it in the life-sustaining process of photosynthesis—which human beings depend for the food we eat. CO_2 is also a naturally occurring greenhouse gas (not the most efficient such gas but certainly the most abundant); its presence in the atmosphere moderates Earth's average surface temperature and keeps nighttime temperatures from plunging to extreme cold.

Over the millennia, the amount of CO_2 in the atmosphere has varied. Evidence is mounting that emissions of CO_2 from the burning of fossil fuels (oil, gas, and coal) combined with changes in land use and land cover resulting from human activities such as deforestation and urbanization are changing the distribution of carbon among the land, atmosphere (CO_2), and oceans. The concentration of atmospheric CO_2 increased more than 25% in the 20th Century, an unprecedented rate of change. It continues to increase, and without mediation, could be 2.5 times greater by the end of this century than it was in 1900. The unprecedented increase in atmospheric CO_2 concentration is likely to have serious climate consequences. In fact, the change in the concentration of CO_2 in the atmosphere may constitute the greatest impact that humans have had on our home planet, and we are only now beginning to understand the potential impact this change may have on society.

Carbon management is a key resource management and policy issue of the 21st Century. New technologies for reduction of carbon emissions and storage of carbon deep underground are options to achieve long-term reduction in the concentration of CO_2 in the atmosphere. As these technologies are being developed and applied, a nearer-term reduction in the rate of increase in atmospheric CO_2 may be possible by increasing storage of carbon in soils, above-ground biomass and aquatic environments. Such carbon sinks currently absorb about 50% of the carbon emitted into the atmosphere annually.

The carbon management program element in the Applied Sciences Program of NASA's Science Mission Directorate uses data and models from NASA's Earth science research to help operational agencies fulfill their mandates to manage carbon and support local, regional, national, and global policy and planning for control of carbon in the environment. NASA also collaborates with academic and government laboratories and operational agencies in the development, testing, and implementation of new technologies for measuring, monitoring, and validation of carbon management practices.

Currently, several U.S. agencies are exploring the potential to sequester carbon in plants and soils. The United States Department of Agriculture's Forest Service, for example, is conducting research on forest plots across the country to understand how carbon is emitted and absorbed in forest ecosystems. NASA Earth science capabilities, observations and models, are helping the Forest Service scale up the information obtained on forest behavior in specific plots to understand the ability of forests to sequester carbon regionally and nationally. The Carbon Query and Estimation Tool (CQUEST) is a product of NASA Earth science now being evaluated by the Forest Service. CQUEST provides users an on-line capability to estimate and monitor carbon sequestration in above ground biomass over large areas. The tool uses NASA Earth science observations (MODIS and other data sets) and a NASA Earth science model called the Carnegie-Ames-Stanford Approach (CASA) to provide the information useful to the Forest Service and others. CQUEST can help the community manage carbon more effectively, anticipate changes in atmospheric carbon concentration and mitigate the potential impact of such changes.

The successful implementation of a carbon management regime requires a synthesis of a wide range of environmental information. NASA Earth observing satellites provide a unique viewpoint for collecting such information. NASA satellites afford us an unprecedented capability to observe the Earth as an integrated system. (See examples on the front.) Additional satellite launches, such as the National Polar–orbiting Operational Earth Satellite System (NPOESS) Preparatory Project (NPP) and the Orbiting Carbon Observatory (OCO), will increase both the quantity and the quality of input data available for decision support tools and highlight NASA's commitment to maximize the use of exploratory research results for the benefit of society.

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